

Version
03.00September
2003

Monitoring Receiver R&S® ESMB

Military and civil monitoring from 9 kHz to 3 GHz
ITU-compliant measurements

The Monitoring Receiver R&S ESMB is ideally suited for military monitoring tasks and spectrum monitoring in line with ITU recommendations as well as for use in radio investigation services.

The range of applications includes:

- ◆ Signal detection
- ◆ Signal search in frequency and memory scan mode
- ◆ Spectrum occupancy measurement
- ◆ RF and IF analysis
- ◆ Coverage measurements (option)
- ◆ Field-strength measurements



General

The R&S ESMB is a monitoring and test receiver for all radio detection and radiomonitoring tasks in line with ITU-R, and for radio investigation services. The compact and sturdy design combined with low weight makes the R&S ESMB a versatile and universal unit for stationary and mobile use.

Applications

The following measurements in line with ITU-R specifications can be performed by the R&S ESMB:

- ◆ Frequency and frequency offset to ITU-R SM 377
- ◆ Field strength to ITU-R SM 378
- ◆ Modulation to ITU-R SM 328
- ◆ Spectrum occupancy and identification with external PC to ITU-R SM 182
- ◆ Bandwidth to ITU-R SM 328

The optimized features of the R&S ESMB allow fast performance of the following additional tasks in military radiomonitoring and radio investigation services:

- ◆ Frequency scan with predefined frequency ranges
- ◆ Memory scan of up to 1000 memory channels
- ◆ RF frequency spectrum (option)
- ◆ Audio monitoring of CW, AM, SSB and FM transmissions
- ◆ Identification

Description

As a ½ 19" unit, the R&S ESMB is ideal both for mobile use and for rack-mounting. It contains the following functional units:

- ◆ A/D and DSP module with digital IF filters, digital demodulators for CW, AM, LSB, USB, PULSE, FM, PM, IQ

and ISB, parameter measurements and FFT processing of IF panoramic display

- ◆ Band and tracking preselection
- ◆ RF frontends for converting the antenna signal into an IF of 10.7 MHz
- ◆ Fast synthesizer
- ◆ Processor system
- ◆ Display and control unit
- ◆ Remote control interface
- ◆ DC/DC converter

Digital IF section

The R&S ESMB covers a frequency range from 9 kHz to 3 GHz. A large number of IF bandwidths is required to process the various signals with optimum signal-to-noise ratio. Maximum quality in a minimum of space can only be ensured by using ultra-modern digital signal processing throughout. The R&S ESMB is equipped with 18 IF filters from 150 Hz to 300 kHz, and up to 1 MHz in the IF panoramic mode.





In conjunction with the Digital Direction Finder R&S DDF190, the Monitoring Receiver R&S ESMB forms a monitoring system with excellent price/performance ratio

Operation

The Monitoring Receiver R&S ESMB features full remote control capability as well as manual control via the front panel.

The operating concept meets all the demands made on a state-of-the-art spectrum monitoring receiver, i.e. all the main functions such as type of modulation, bandwidth, etc can easily be set directly via labelled keys.

Menu control is organized in priority levels so that signal processing is not interrupted by menu changes and the user has an optimized view of current operations.

Scan modes

Frequency scan

It is possible to define a frequency range to which a complete data set can be allocated. In addition to receiver settings, the following scan parameters are included in the data set:

- ◆ Step width
- ◆ Signal threshold (dB μ V)
- ◆ Dwell time
- ◆ Hold time
- ◆ Number of scans
- ◆ Signal-controlled continuation
- ◆ Suppression (individual frequencies or search ranges)

Memory scan

The R&S ESMB uses 1000 definable memory locations. A complete data set such as frequency, mode of demodulation, bandwidth, squelch level, etc can be assigned to each memory location. The content of any memory location can be transferred to the receiver manually using the RCL key.

Frequency spectrum

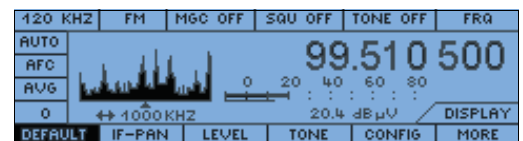
Fitted with the frequency spectrum option **DIGI Scan**, the R&S ESMB scans the frequency range of interest with digital control and displays the associated spectrum.

Emissions detected can be seen at a glance. Aural monitoring of the information is possible by simply pressing a soft-key. The R&S ESMB then goes to the DIGI Scan listen mode. The stored spectrum is displayed in the background, and the emission of interest can be selected and monitored by marking it with the frequency cursor.

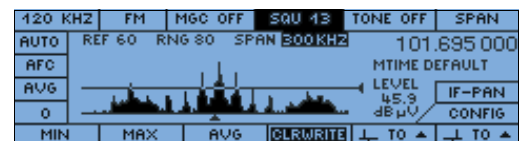
Location of miniature transmitters at close range is possible in the **differential mode** of the DIGI Scan option. In this mode, the displayed spectrum is stored as a reference. Current spectra are superimposed on the reference spectrum, and any new signals or variations in signal strength are clearly discernible as peaks. If the measurement is carried out while walking across the room, the field strength of transmitters at close range varies to a greater extent than that of transmitters located far away. This differential display ensures fast and reliable location of miniature transmitters even in the case of spread-spectrum transmission.

Optimized view for current task

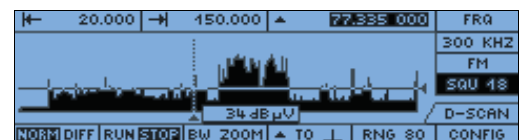
Overview



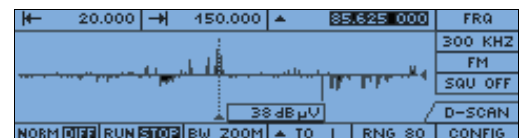
IF panoramic display



DIGI Scan listen mode



DIGI Scan differential mode



R&S ESMB in measurement mode

Bandwidth measurement

300 KHZ	FM	MGC OFF	SQU OFF	TONE OFF	FRQ
AUTO	REF 30	RNG 80	SPAN 300KHZ		105.700 000
AFC					MTIME 5.0000 S
AVG					BANDW MC
0					153.00 KHZ
FREQ	BANDW	MVALUE		CONFIG	MORE

Modulation measurement

9 KHZ	AM	MGC OFF	SQU OFF	TONE OFF	FRQ
AUTO	MOD DEPTH		FREQ DEV		0.801 000
AFC	+	80.6 %	+	1.296 KHZ	MTIME 2.5000 S
AVG	-	79.5 %	-	1.343 KHZ	MC
0	OFFSET		LEVEL	BANDW	
	0.000 KHZ		41.2 dBµV	1.750 KHZ	
FREQ	BANDW	MVALUE		CONFIG	MORE

120 KHZ	FM	MGC OFF	SQU OFF	TONE OFF	FRQ
AUTO	MOD DEPTH		FREQ DEV		105.700 000
AFC	+	59.4 %	+	5.045 KHZ	MTIME 2.5000 S
AVG	-	54.1 %	-	5.068 KHZ	MC
0	OFFSET		LEVEL	BANDW	
	-0.087 KHZ		53.7 dBµV	60.25 KHZ	
FREQ	BANDW	MVALUE		CONFIG	MORE

9 KHZ	PM	MGC OFF	SQU OFF	TONE OFF	FRQ
AUTO	MOD DEPTH		PHASE DEV		0.801 600
AFC	+	78.6 %	+	1.57 RAD	MTIME 2.5000 S
AVG	-	70.3 %	-		MC
0	OFFSET		LEVEL	BANDW	
	-0.730 KHZ		42.8 dBµV	1.500 KHZ	
FREQ	BANDW	MVALUE		CONFIG	MORE

When equipped with the R&S EB200CM option, the R&S ESMB can also be used for coverage measurements. In this configuration, it is possible to perform up to 2000 triggered level measurements on one frequency or up to 200 multichannel measurements (with any frequency hopping). This option is only available via the remote-control interface.

The R&S ESMB together with the R&S ROMES software form a coverage measurement system with excellent price/performance ratio.

Interfaces

For system applications, the receiver is equipped with a number of important interfaces:

- ◆ Baseband output (digital)
- ◆ AF output (digital)
- ◆ IF 10.7 MHz \pm 2.5 MHz, VHF/UHF
- ◆ IF 10.7 MHz \pm 5 kHz, HF
- ◆ uncontrolled for external panoramic display
- ◆ AF balanced 600 Ω , 0 dBm
- ◆ Output for external loudspeaker, 4 Ω , 500 mW
- ◆ Headphone socket via volume control
- ◆ Output for antenna control with antenna number
- ◆ Connector for internal/external reference frequency, 10 MHz

Remote-control interface

LAN TCP/IP (Ethernet 10Base-T), optional 9-pin RS-232-C. The LAN interface (Ethernet 10Base-T) with TCP/IP protocol fitted as standard enables the R&S ESMB to be integrated into systems of varying complexity. The high data rate of this interface not only allows full control of all

device functions as well as data output, but also transmission of the digital AF. With the aid of the DIGI Scan option, data for 20 000 channels/s can be output in the scan mode.

Designed to meet the standards

State-of-the-art design

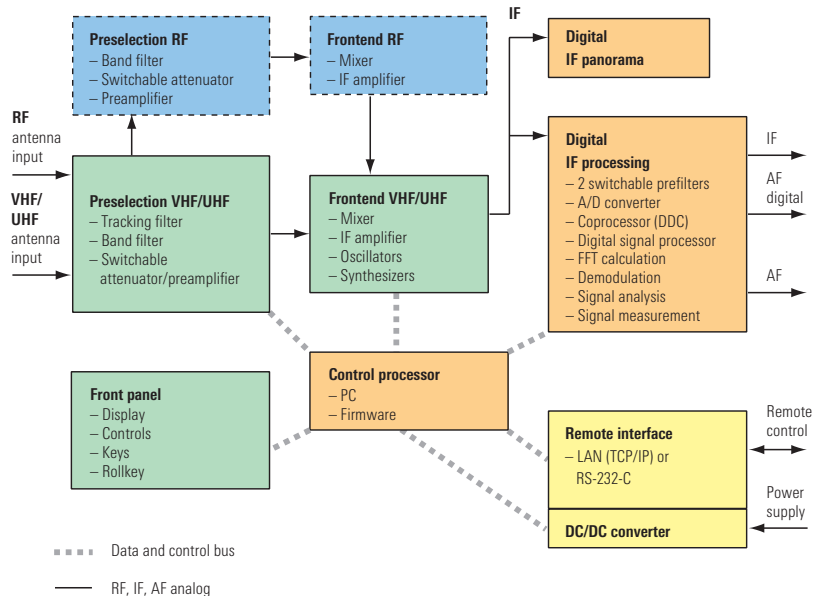
The receiver is designed for both mobile and stationary operation. Careful screening and filters in all the input and output lines ensure extremely low spurious emissions and high interference rejection.

BITE

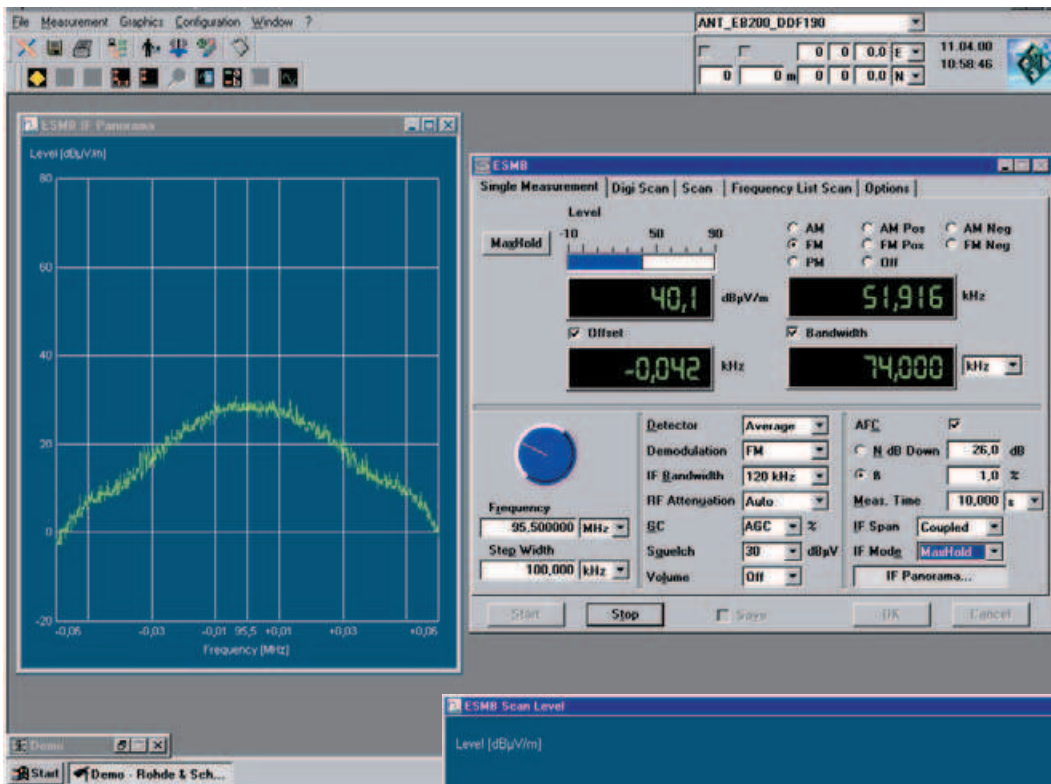
The receiver is permanently monitored by built-in test equipment (BITE). If deviations from the nominal specifications are detected, an error message is output with a code indicating the type of error.

Serviceability

Modern design and the use of plug-in modules ensure short repair times. All the modules can be replaced without any recalibration or adjustments being required.



Block diagram of the Monitoring Receiver R&S ESMB



Bandwidth and modulation measurements with panoramic display

Use in computer-controlled systems

Full use of the performance features of the receiver can be made in the remote-control mode via LAN using a suitable PC and the Spectrum Monitoring Software R&S ARGUS or R&S RAMON.

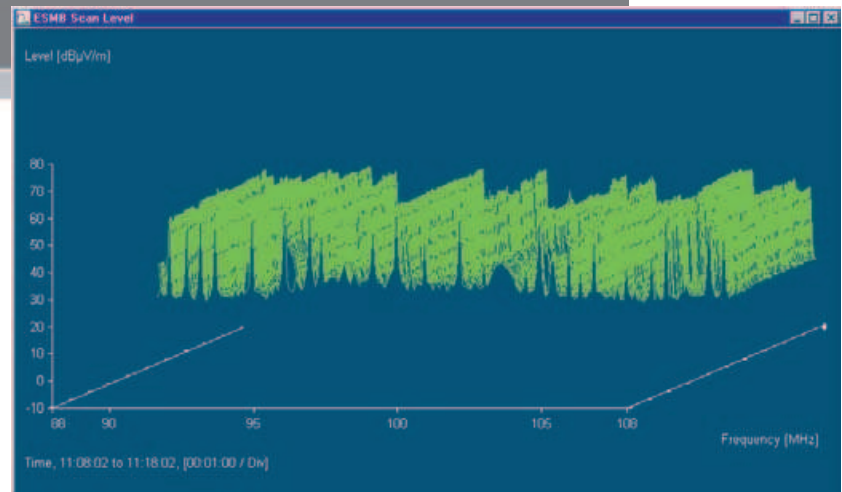
R&S RAMON, which is primarily used in military and security applications, enables fast frequency detection and transfer to support monitoring receivers (concentration on interactive operation and signal identification).

R&S ARGUS is intended for applications focusing on measurements, and is therefore particularly suitable for frequency management tasks.

For basic tasks, the R&S ARGUS MON software is available for remote control of the R&S ESMB. The functionality of this software, which features a favourable price/performance ratio, is optimally tailored to the capabilities of the R&S ESMB. It allows remote control of all settings, measurement and scan functions as well as saving of measured data such as frequency, level, offset, date and time. The basic R&S ARGUS MON software can be

upgraded to R&S ARGUS for use in more complex systems. The pictures above show how easy-to-use and user-friendly R&S ARGUS MON is. The R&S ESMB together with R&S ARGUS MON is a cost-efficient basic system that fulfills all the ITU recommendations.

Detailed information is provided in the data sheet (PD0757.4818).



Scan with 3D waterfall diagram

Specifications

Frequency range	
Base unit	20 MHz to 3 GHz
Base unit with HF Option R&S ESMBHF	9 kHz to 3 GHz
Frequency setting via keypad or rollkey	1 kHz, 100 Hz, 10 Hz, 1 Hz; or in selectable increments
Frequency accuracy	$\leq 0.5 \times 10^{-6}$
Input for external reference	10 MHz
Synthesizer setting time	≤ 3 ms, typ. 1 ms
Oscillator phase noise	≤ -120 dBc (1 Hz) at 10 kHz offset (HF range) ≤ -100 dBc (1 Hz) at 10 kHz offset (VHF/UHF range)
Antenna inputs	
VSWR	≤ 3 , typ. 1.5 for HF range ≤ 2.5 , typ. 1.8 for VHF/UHF range
Oscillator reradiation	≤ -107 dBm
Input selection	9 kHz to 30 MHz 20 (30) MHz to 1500 MHz 1500 MHz to 3000 MHz
	5 bandpass filters tracking preselection highpass, lowpass
Interference rejection, nonlinearities – HF range (only with HF Option R&S ESMBHF)	
Image frequency rejection	≥ 90 dB, typ. 100 dB
IF rejection	≥ 90 dB, typ. 100 dB
2nd order intercept point	≥ 50 dBm, typ. 60 dBm (ATT off)
3rd order intercept point ¹⁾	≥ 20 dBm, typ. 25 dBm (ATT off)
Internal spurious signals	≤ -107 dBm
Interference rejection, nonlinearities – VHF/UHF range	
Image frequency rejection	≥ 80 dB, typ. 95 dB
IF rejection	≥ 90 dB, typ. 100 dB
2nd order intercept point	≥ 40 dBm, typ. 55 dBm (low distortion mode)
3rd order intercept point ²⁾	≥ 12 dBm, typ. 18 dBm (low distortion mode)
Internal spurious signals	≤ -107 dBm
Sensitivity – HF range (only with HF Option R&S ESMBHF)	
Overall noise figure (including AF section)	≤ 14 dB, typ. 10 dB ($f \geq 50$ kHz, ATT off), 0.1 MHz to 30 MHz
Signal-to-noise ratio	measurement with telephone filter
	CW, bandwidth 300 Hz, $V = 0.6 \mu\text{V}$ SSB, bandwidth 2.5 kHz, $V = 1 \mu\text{V}$ AM, bandwidth 9 kHz, $f_{\text{mod}} = 1$ kHz, $m = 0.5$, $V = 1 \mu\text{V}$
	≥ 10 dB
	≥ 10 dB
	≥ 10 dB

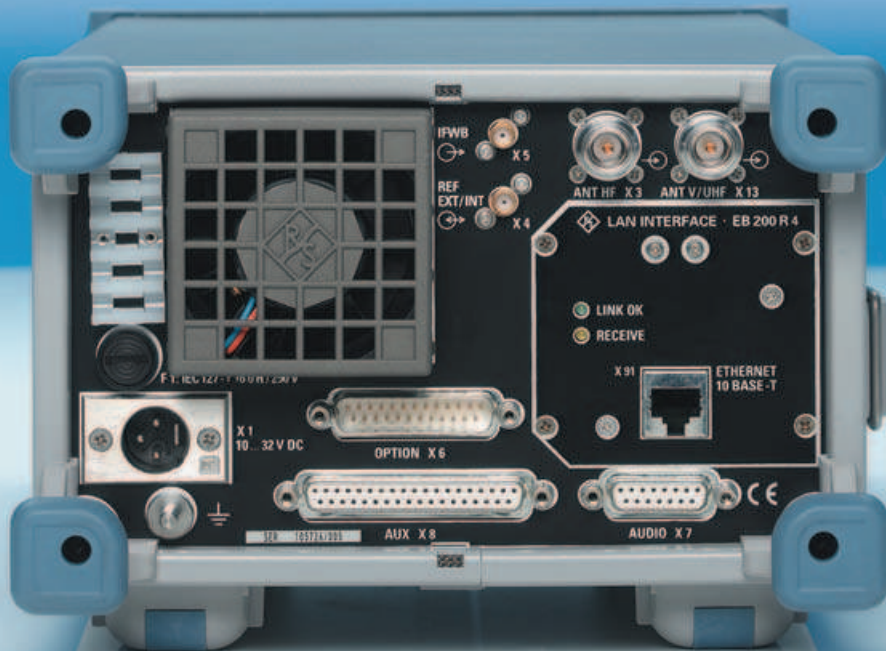
Sensitivity – VHF/UHF range	
Overall noise figure (including AF section)	≤ 12 dB, typ. 9 dB, 20 (30) MHz to 2700 MHz (low noise mode)
Signal-to-noise ratio	measurement with telephone filter
	AM, bandwidth 9 kHz, $f_{\text{mod}} = 1$ kHz, $m = 0.5$ 20 (30) MHz to 2700 MHz, $V = 1 \mu\text{V}$ 2.7 GHz to 3 GHz, $V = 1.3 \mu\text{V}$
	≥ 10 dB (low noise mode), typ. 16 dB
	FM, bandwidth 15 kHz, $f_{\text{mod}} = 1$ kHz, deviation = 5 kHz 20 (30) MHz to 2700 MHz, $V = 1 \mu\text{V}$ 2.7 GHz to 3 GHz, $V = 1.3 \mu\text{V}$
	≥ 25 dB (low noise mode), typ. 30 dB
Detection modes	
	AM, FM, PM, USB, LSB, CW, ISB, PULSE, IQ
IF bandwidths for level detection and offset measurement	23 filters (150 Hz to 1 MHz)
IF bandwidths with standard demodulation (–6 dB bandwidth)	0.15, 0.3, 0.6, 1, 1.5, 2.4, 3, 4, 6, 8, 9, 15, 30, 100, 120, 150, 250, 300 kHz (reduced IF bandwidth in HF range: ± 5 kHz)
Squelch, signal-controlled	-30 dB μV to 110 dB μV
Gain control	AGC, MGC (120 dB)
AFC	digital retuning for unstable signals
Modulation measurement	
AM ($f_{\text{max}} = 100$ kHz) Indication error	$m = 1\%$ to 99% (resolution 0.1%) $< 5\%$ for $m = 50\%$, $S/N > 40$ dB, $AF = 1$ kHz
FM ($f_{\text{max}} = 100$ kHz) Indication error	deviation max. 125 kHz less modulation frequency (resolution 0.001 kHz)
Narrow bandwidths (≤ 15 kHz)	100 Hz plus 3% of reading
Broad bandwidths (≤ 250 kHz)	2 kHz plus 3% of reading for $S/N > 40$ dB, $AF = 1$ kHz
PM ($f = 0.3$ kHz to 5 kHz)	$\Delta\phi = 0$ to 4π $\Delta\phi = 0$ to 12.5 rad (resolution 0.01 rad)
Indication error	< 0.1 rad plus 5% of reading for $S/N > 40$ dB, $AF = 1$ kHz

¹⁾ Frequency spacing between intermodulating signals ≥ 30 kHz.

²⁾ Frequency spacing between intermodulating signals ≥ 2.2 MHz.

Level and offset measurement	
Offset indication	graphically with tuning markers or numerically
Signal level	-30 dB μ V to 110 dB μ V
Error	$\leq \pm 1.5$ dB typ. ± 0.8 dB (HF range) typ. ± 1.0 dB (VHF/UHF range) for $V = 20$ dB μ V to 100 dB μ V, AVG, 0°C to 45°C
Display	numeric, 3 digits, resolution 0.1 dB or graphic as level line acoustic indication by level tone
Level indication mode	AVG, PEAK, FAST, RMS
Field strength (dB μ V/m)	level range depending on antenna used
Display	numeric
IF panoramic display	internal module
Span range	0.15 kHz to 1000 kHz (23 steps)
Scan characteristics	
Automatic memory scan	1000 definable memory locations, typ. 200 channels/s (300 kHz IF filter)

Frequency scan	start/stop/step and 100 suppress ranges, typ. 250 channels/s (300 kHz IF filter)
DIGI Scan (option)	RF spectrum with user-selectable start/stop frequency, typ. 3000 MHz/s (300 kHz IF filter)
Inputs/outputs	
Reference frequency connector	10 MHz, SMA, bidirectional
IF 10.7 MHz, wideband	± 2.5 MHz (VHF/UHF range), ± 5 kHz (HF range), uncontrolled for external panoramic display, SMA
Baseband output (digital)	serial, 2 x 16 bit (clock, data, frame)
AF output (digital)	AF signal, 2 x 16 bit, AES/EBU to AES3-1985 (ANSI S4.40-1985)
AF output, balanced	600 Ω , 0 dBm
Loudspeaker output	4 Ω , 500 mW
Headphone output	via volume control
BITE	monitoring of test signals by means of loop test
Data interface	LAN (Ethernet 10Base-T) or 9-pin RS-232-C, PPP



Rear view of the R&S ESMB

General data

Rated temperature range	0°C to +50°C
Operating temperature range	-10°C to +55°C
Storage temperature range	-40°C to +70°C
Humidity	max. 80%, cyclic test 25°C/55°C max. 95% without condensation
Shock	DIN IEC 60068-2-27 (MIL-STD-810E, MIL-T-28800D), 40 g, spectrum 45 Hz to 2 kHz
Vibration (sinusoidal)	DIN IEC 60068-2-6 (MIL-T-28800D), 5 Hz to 55 Hz, 0.15 mm amplitude, 55 Hz to 150 Hz, 0.5 g
Vibration (random)	DIN IEC 60068-2-64, 10 Hz to 500 Hz, 1.9 g rms
EMC	DIN EN 61000-6-3, 61000-6-4
Power supply	10 V to 32 V DC (max. 40 W) or 100 V to 240 V, 50 Hz to 60 Hz via external AC/DC power supply
Dimensions (W × H × D)	227 mm × 153 mm × 474 mm
Rack model (½ 19" × 3 HU)	210 mm × 132 mm × 460 mm
Weight	8 kg

Ordering information

Order Designation	Type	Order No.
Monitoring Receiver (with external power supply)	R&S ESMB	4056.6000.02
HF Option 9 kHz to 30 MHz	R&S ESMBHF	4056.6100.02
Coverage Measurement Option	R&S EB200CM	4052.9804.02
Frequency Spectrum Option DIGI Scan	R&S ESMBDS	4056.6200.02
RS-232-C Serial Interface	R&S ESMBR2	4052.9056.02
Software		
R&S ARGUS basic module		3027.7363.0x
R&S ARGUS device driver for R&S ESMB		3027.7363.45
R&S RAMON basic module RA/BASIC		3020.9490.0x
R&S RAMON device driver EMB/CTL		3020.8264.02

Printed in Germany (U sk)

More information at
www.rohde-schwarz.com
(search term: ESMB)



Rohde & Schwarz GmbH & Co. KG · Mühlhofstraße 15 · 81671 München · Germany

P.O. B. 801469 · 81614 München · Germany · Telephone +49 89 4129-0 · Fax +49 89 4129-13247 · www.rohde-schwarz.com

www.valuetronics.com

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG · Trade names are trademarks of the owners
PD 0758.0716.32 · Monitoring Receiver R&S® ESMB · Version 03.00 · September 2003 · Data without tolerance limits is not binding · Subject to change